Campus Based Snack Food Vending Consumption

A Senior Honors Thesis

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ABSTRACT

Changes in eating habits and behaviors are needed to reverse the obesity trend in the United States. The Ohio State University recently mandated (through contract specification) implementation of a healthy vending snack program using Snackwise®. Snackwise® is a software program developed by Nationwide Children's Hospital that calculates nutrient density scores using 11 parameters from the nutrition facts label. Composite scores are used to group snack foods into easily understood categories: "green" items should be chosen most often, "yellow" chosen occasionally, and "red" chosen least often. As specified in the contract, the university requires that specific proportions of green, yellow and red items be provided in vending machines across campus; 28.5% green, 43% yellow, and 28.5% red. While the intent of this program is to favorably impact snack choices, no data exists that describes who uses vending machines, how frequently they do so, what they purchase and why.

This study evaluated the purchases of vending machine clientele to create a snapshot of what drives consumers in their snacking purchases. The objective of the study was to determine who makes purchases at vending machines on campus, what their purchases are, what factors drive their purchase, and how often they purchase food at vending machines.

The study was a cross-sectional survey of vending consumers at 8 pre-selected campus vending machines. Trained interviewers observed and interviewed 478 vending

patrons during a four day study period. A convenience sample of building locations (n= 8) was drawn from a selection of the highest grossing vending machines on campus, stratified by two types of buildings: residential buildings and classroom buildings. Variables being measured included vending choice, reason for vending choice, and self-reported frequency of vending purchases. Select demographic variables were also collected. These included gender, age, and university affiliation. Students comprised the largest proportion of vending machine clientele at 85% of the surveyed participants. Consumers between the ages of 18-24 also made up a large portion of consumers at 77% of surveyed participants. For those patrons aged 18-24, the items purchased most often were red (58%) followed by yellow (30%) and green (9%). The two strongest factors driving their purchases were hunger (43%) and convenience (42%). Over half the surveyed population of consumers aged 18-24 make vending purchases at least 1 time per week (53%). The results of this study will be used to design interventions aimed at and promoting healthier snack food choices.

Dedicated to my parents for their support and encouragement.

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CHAPTER 1

Introduction

In the United States, 18.4 million people are currently enrolled as students in college or university programs (1). With 40% of food consumed away from the home, the food choices of students and employees on college campuses are of significant nutritional consequence (2). Colleges and universities are able to meet the food demands of their population with options such as full-service restaurants, coffee shops, snack shops, grocery stores and vending machines. Of these options, vending machines traditionally fulfill a unique snacking niche with convenient locations and purportedly inexpensive choices.

Not only do vending machines traditionally provide convenient and cheap snacks, they also traditionally provide energy dense, nutrient poor snacking options. In the United States, snacking frequency has not changed significantly since 1971 at about 2 snacks per day (3). However, the average amount of energy consumed per snack has increased from 185 kilocalories to 234 kilocalories (3). This energy increase per snack could likely be a contributing factor to the increase in obesity among adults in the United States. From 1960 to 2006, obesity among adults in the United States has almost tripled from 13.4% to 35.1% of the total population (4).

Changes in eating habits and behaviors are needed to reverse the obesity trend in the United States. The Ohio State University recently adopted a new 'healthy snacking' program for vending machines in an attempt to promote healthier choices. The new program uses the Snackwise® nutrition rating system to evaluate the nutrient density of vending machine items and assigns color-coded identification to items based on overall healthfulness. Items that are the best choice are green, ones that should be chosen occasionally are yellow, and items to be chosen rarely are red. Per contract specification, vending machines on campus must be stocked with food items in the following proportions: red (28.5%), yellow (43%) and green (28.5%). However, there are currently no educational materials provided on the machine to indicate which items have red, yellow and green Snackwise® ratings.

This study was designed to create a baseline snapshot of vending consumers on a college campus. The objectives of this study are to determine who purchases food from vending machines on The Ohio State University's campus, what their purchases are, what the driving factors behind their purchases are, and how frequently they make vending machine purchases. This research will be used to tailor interventions designed to promote purchases of healthier vending snack items.

CHAPTER 2

Review of Literature

The prevalence of overweight and obese American adults is increasing at an alarming rate. According to the Centers for Disease Control (CDC), from 1960 to 2006 the percentage of American adults with obese body mass index (BMI) levels almost tripled from 13.4% to 35.1% of the total population (4). Average BMI for men and women has increased 11.9 percent and 14.4 percent respectively from 1971 to 2006 (2). Also, from 1971 to 2000, the average daily caloric intake of adult Americans has increased at a rate of 8% for males and 22% for females (5). Data also shows that increased daily eating frequency results in significant increased energy intake, from 1446 kcals for 1-2 eating occasions per day, to 2540 kcals for 6+ eating occasions (6).

Although total kilocalorie consumption increased with increased daily eating frequency, percent energy intake from protein and fat has decreased, whereas percent energy intake from carbohydrates has increased (6, 7). This data suggests that the extra calories consumed by more frequent eaters likely come from foods high in carbohydrates, such as snack foods and beverages high in simple sugars. From 1976 to 2002, the average number of snacking episodes per American adult has not changed significantly at approximately 2 snacks per day (3). However, the average amount of energy consumed per snack has increased from 185 kilocalories to 234 kilocalories, and the average energy

density of snacks has increased almost 50% from 0.89 kilocalories/gram to 1.32 kilocalories/gram (3).

In addition to increased energy consumption from snack food, another speculated contributing factor to the increase in adult obesity is the likely increased consumption of food outside of the home. In 1971, 24% of food was consumed away from the home (2). By 2006, that number had increased to 40% (2). Over the same time span, the percent of energy consumed away from the home increased disproportionally by gender; an increase of 36.7% for men and 72.5% for women (2). Men and women with higher education levels were more likely to eat higher proportions of daily calories away from home than less educated men and women (2).

Because eating away from the home is implicated as a contributing factor in the adult obesity epidemic, and increased frequency of eating occasions is shown to increase daily calorie intake, it is important to note ways in which American adults snack while away from the home. Numerous options exist, including fast food, grocery stores, gas stations, restaurants and cafeterias. But when specifically searching for snacking facilities and venues provided outside of the home, the convenient, affordable choice is often a vending machine.

Data about vending machine consumption among adults is sparse. French evaluated adult vending consumption at twelve worksites and twelve secondary schools as part of a larger study titled CHIPS (Changing Individuals' Purchase of Snacks through vending machines) (8). Factors that affect vending machine purchases among working adults were investigated. French found that taste was the most important consideration of adults when choosing vending snack items, followed by hunger, snack price, and value

(8). These findings are similar to another study conducted by Glanz et al (9). When investigating the factors that drive overall food choices of American adults, Glanz et al found that taste was again found to be the most important consideration, followed by cost, nutrition, and convenience (9). Similarly, in a study conducted by Blanck, convenience was the most important factor affecting adults' lunch choices, followed by taste, cost and health (10).

These factors affecting food choices for American adults, especially in regard to vending, have helped to shape this study to determine if vending consumers at The Ohio State University have similar reasons for their purchasing patterns. It is important to study the nutrition behaviors of the adult population on college and university campuses due to the size and scope of potential nutritional impact. Changes in eating habits and behaviors are needed to reverse the obesity trend in the United States. 18.4 million Americans are currently enrolled as students in college or university programs (1). Additionally, the non-student population on college campuses makes up 2.8 million members of the nation's workforce (11). Since 40% of food is consumed away from the home, the food provided by colleges and universities can have significant nutritional impact on the populations they serve (2).

The Ohio State University recently mandated (through contract specification) implementation of a healthy vending snack program using Snackwise®. Snackwise® is a software program developed by Nationwide Children's Hospital in Columbus, Ohio that calculates nutrient density scores using 11 parameters from the nutrition facts label. Composite scores are used to group snack foods into easily understood categories: "green" items should be chosen most often, "yellow" chosen occasionally, and "red"

chosen least often. As specified in the contract, the university requires that specific proportions of green, yellow and red items be provided in vending machines across campus; 28.5% green, 43% yellow, and 28.5% red. While the intent of this program is to favorably impact snack choices, no data exists that describes who uses vending machines, how frequently they do so, what they purchase and why. Therefore, the objective of this study is to describe vending machine clients, what they purchase, and why.

Specific research aims are:

1. Describe vending machine clients
2. Describe purchases made by vending machine clients
3. Describe reasons for purchases made by vending machine clients
4. Describe how frequently vending machine clients use vending machines

CHAPTER 3

Methodology

Research Design

The design for this pilot study was a cross-sectional survey of vending consumers at eight pre-selected campus vending machines. Vending consumers were observed and interviewed by trained interviewers. The protocol was approved as Exempt by the Institutional Review Board (IRB) for social and behavioral human subject research.

Vending Machine Selection

The convenience sample of eight vending machines was drawn from a selection of the highest grossing vending machines in two types of buildings on campus: residential buildings and classroom buildings. Four machines from each building category were selected. Residence hall machines were selected based on percent freshmen residents, while machines residing within classroom buildings were selected based on total classroom seating capacity. Each week, four machines were studied. Two of the four machines were in residential buildings, one in a high-percentage freshman building and one in a non high-percentage freshman building. The remaining two machines were in classroom buildings, one in a high classroom seating capacity building and one in a low classroom seating capacity building.

Instrumentation

Variables being measured include vending choice, reason for vending choice, and self-reported frequency of vending purchases. Also collected were select demographic variables. These include gender, age, and university affiliation (student, faculty, staff or other).

Interviewers were taught observation techniques and how to administer the survey in a one-hour training session. All interviewers completed Collaborative Institutional Training Initiative (CITI) training and Conflict Of Interest (COI) documentation. Vending purchases and gender were recorded by the interviewers for each consumer observed. Next, consumers were asked to give their voluntary consent to participate in a survey. Each interviewer followed a script to obtain participant consent (Appendix A). No personal information was collected from vending consumers.

The survey consisted of 4 questions and took no longer than one minute to complete (Appendix B). Question 1 was designed to evaluate the consumer's university affiliation. Five response categories were provided: Student; Staff; Faculty; and Other. Question 2 was designed to evaluate the self-reported frequency of vending purchases. Six response categories were provided: More than 3 times per week; 1-3 times per week; 2 times per month; 1 time per month; Less than 1 time per month; and Unknown. Question 3 was designed to evaluate reason for vending choice. Five response categories were provided: Hunger; Convenience; Cost; Taste; and Other. Question 4 was designed to evaluate consumer age. Six response categories were provided: 18-24; 25-34; 35-44; 45-54; 55+; and Unknown.

Methods

Data was collected during two collection periods over a two-week period. Four machines were evaluated during each data collection period. During each data collection period, the four machines were observed by the trained interviewers on Tuesday and Wednesday for 12 hours, 7am-7pm, each day. Table 1 outlines the buildings chosen and dates that each machine was observed.

Table 1 - Buildings

Building Name	**Type of Building**	**Dates Observed**
Park Hall	Residential	4/20 - 4/21
Drackett Tower	Residential	4/20 - 4/21
McPherson Lab	Classroom	4/20 - 4/21
University Hall	Classroom	4/20 - 4/21
Paterson Hall	Residential	4/27 - 4/28
Neil Building	Residential	4/27 - 4/28
Schoenbaum Hall	Classroom	4/27 - 4/28
Page Hall	Classroom	4/27 - 4/28

Internal Validity

This research is a pilot investigation and is not designed to be generalized to the campus population. The vending machines that were observed were conveniently selected to create the most variation in the population of vending consumers. The results from the study are not intended to be a valid representation of campus vending consumers, but are designed to gain insight for further research.

Data Analysis

Data was analyzed using descriptive statistics for all variables. Means, standard deviations and percentages were calculated to describe purchase behavior for gender, age, university affiliation, vending choice, reason for choice, and frequency of vending purchases. Two-sample t-values were also used to evaluate differences between Week 1 and Week 2 data, and chi-squared analysis was used to evaluate gender differences for vending consumer purchase, reason for purchase, and frequency variables.

CHAPTER 4

Results

A total of 478 vending consumers' purchases were observed and 356 consumers participated in the questionnaire (74% participation rate). Although data was collected for different buildings during Week 1 and Week 2 of data collection, the percentages for studied variables were very similar (Table 2). A two-sample t-test was used to test for significant differences for university affiliation. No significant differences were found between Week 1 and Week 2. Therefore, data were pooled into one sample.

The sample size from the four machines in residential buildings made up only 19% of the total sample size of consumers. Statistically significant differences found between residential consumers and classroom consumers were hard to determine due to the small sample size. Therefore, analysis was restricted to the aggregated total of these two building types.

Demographics

The three demographic variables studied were gender, university affiliation, and age. The largest demographic populations of vending consumers consisted of students (86%) and persons aged 18-24 (77%). Females made up 55% of consumers, and 45% were male (Figure 1). The additional university affiliation distinctions made up a very

Table 2 – Data Comparison

Weekly Data Comparison (%)			
	Week 1	**Week 2**	**Combined**
Total	55%	45%	100%
Survey Participants	81%	67%	74%
Male	46%	44%	45%
Female	54%	56%	55%
Student	87%	85%	86%
Staff	10%	10%	10%
Faculty	3%	1%	2%
Other	0%	3%	1%
18-24	75%	81%	77%
25-34	13%	8%	11%
35-44	4%	2%	3%
45-54	6%	6%	6%
55+	2%	3%	2%
Unknown	0%	1%	0%
Red	63%	55%	59%
Yellow	25%	31%	27%
Green	7%	10%	8%
Mint	2%	3%	3%
Unknown	3%	1%	2%
Hunger	45%	39%	43%
Convenience	39%	43%	41%
Cost	0%	1%	1%
Taste	11%	10%	11%
Other	5%	6%	5%
More 3 times/wk	11%	13%	12%
1-3 times/wk	40%	44%	42%
2 times/mo	19%	15%	17%
1 time/mo	15%	9%	12%
Less than 1 time/mo	16%	17%	16%
Unknown	0%	1%	1%

small portion of the overall sample. Staff made up 10% of the sample, faculty 3%, and other 1% (Figure 2). For the age demographic, most consumers were aged 18-24 (77%).

Persons aged 25-34 made up 11% of the sample, followed by ages 35-44 (3%), 45-54 (6%), and 55+ (2%). (Figure 3)

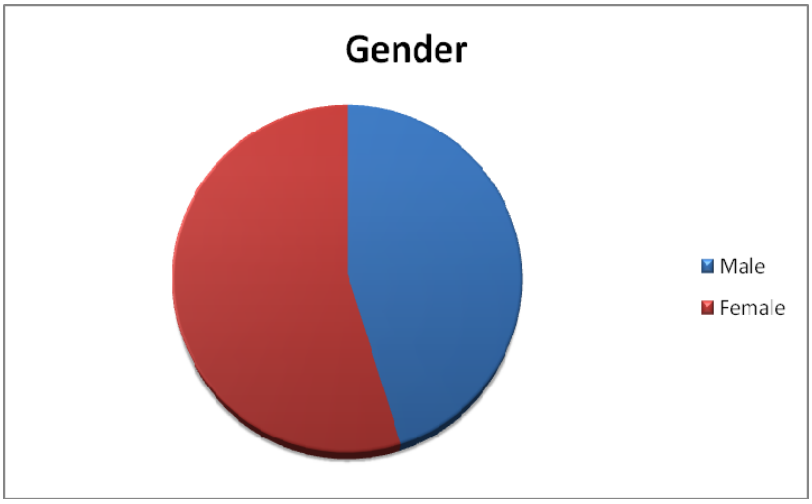

Figure 1 – Gender

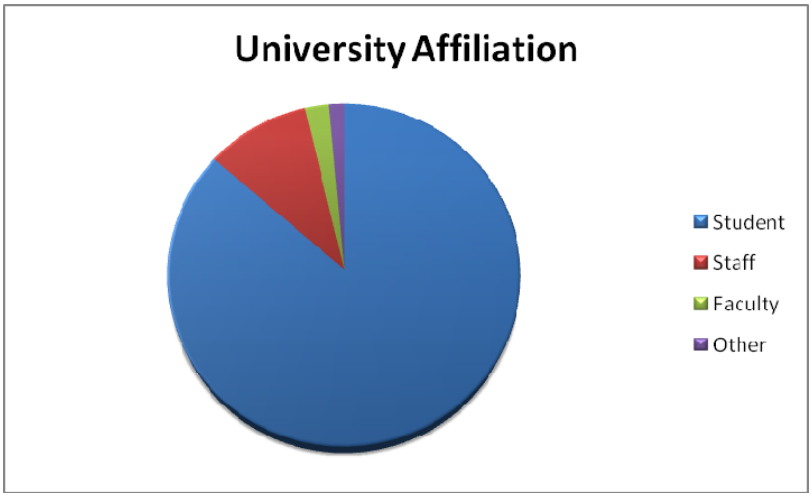

Figure 2 – University Affiliation

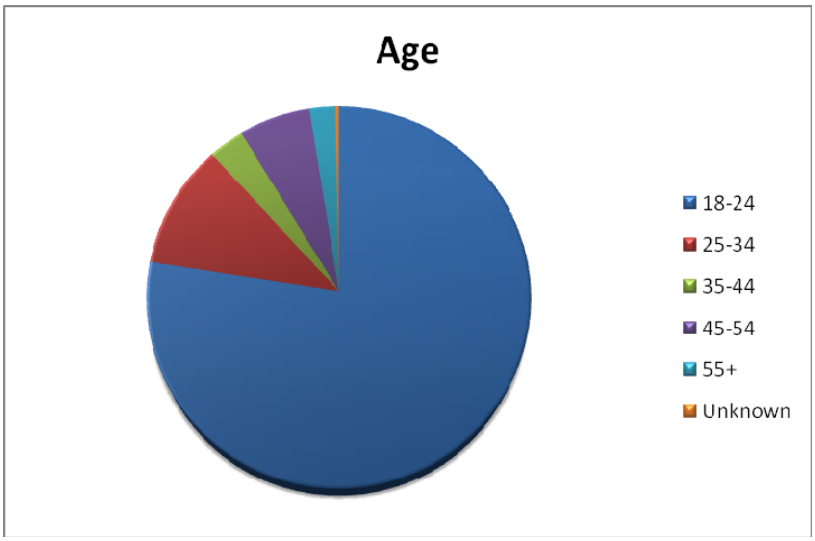

Figure 3 – Age

Item Purchase

Further analysis was restricted to the 18-24 year old consumer demographic since the sample size of other age groups was too small for further analysis. Chi-squared analysis was used to evaluate differences in vending choices (red, yellow, green), reason for purchase, and purchasing frequency between males and females, ages 18-24. No statistically significant differences between male and female purchasing behavior, reason, or frequency was found ($p > 0.05$).

Analysis of item purchases revealed that persons aged 18-24 purchased red items most often (58%) followed by yellow items (30%) and green items (9%). There were 7 purchases (3%) that made up the "Mint" category, which is not assigned a red, green or yellow rating. Unknown purchases (1%) were purchases that the data collectors were unable to observe (Table 3).

Table 3 – Item Purchased (18-24)

Item Purchased (18-24, n=275)					
	Red	Yellow	Green	Mint	Unknown
Overall (counts)	159	82	25	7	2
Overall (%)	58%	30%	9%	3%	1%

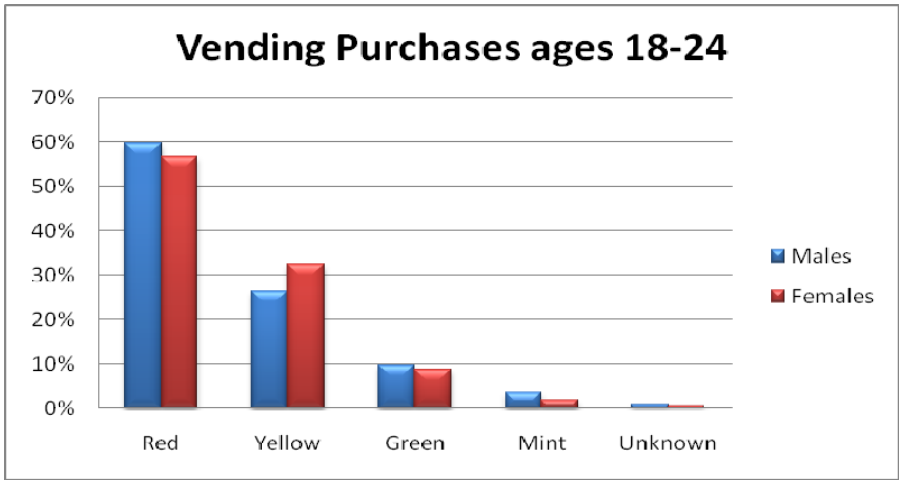

Figure 4 – Item Purchased (18-24)

Reason for Purchase

Hunger (43%) and convenience (42%) were the highest reported reasons for the purchases of vending consumers aged 18-24, followed by taste (11%), 'Other' (4%) and cost (0%) (Table 4). Males indicated convenience as the reason for their purchase 48% of the time, followed by hunger at 38%. Females responded oppositely with hunger at 47% and convenience at 37% of purchase reason (Figure 5).

Table 4 – Reason for Purchase (18-24)

Reason for Purchase (18-24, n=275)					
	Hunger	Convenience	Cost	Taste	Other
Overall (counts)	119	115	1	30	10
Overall (%)	43%	42%	0%	11%	4%

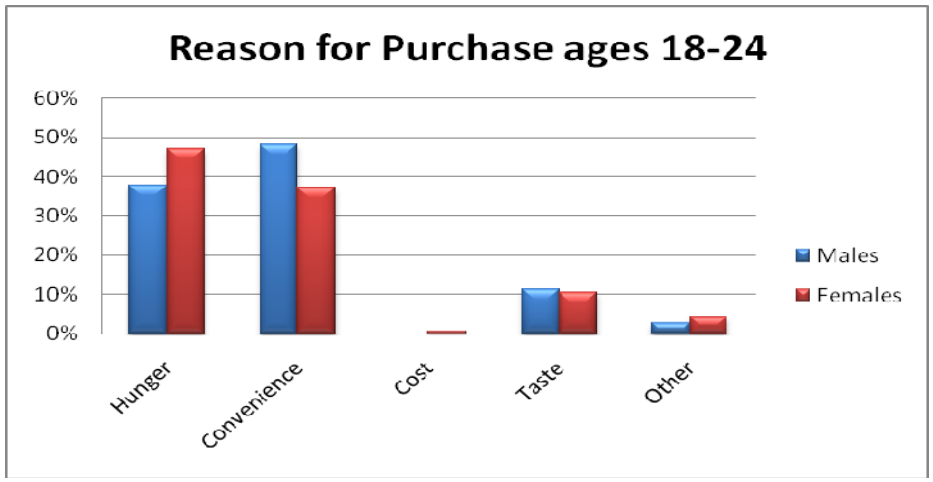

Figure 5 – Reason for Purchase (18-24)

Frequency of Purchase

The vending purchasing frequency most often reported by 18-24 year old consumers was 1 to 3 times per week (41%), followed by 2 times per month (17%), less than 1 time per month (17%), one time per month (13%), and 3 times or more per week (12%) (Table 5). Male and female totals were very similar (Figure 6).

Table 5 – Frequency of Purchases (18-24)

Frequency of Vending Purchases (18-24, n=275)						
	More 3 times/wk	1-3 times/wk	2 times/mo	1 time/mo	Less than 1 time/mo	Unknown
Overall (count)	32	113	47	35	47	0
Overall (%)	12%	41%	17%	13%	17%	0%

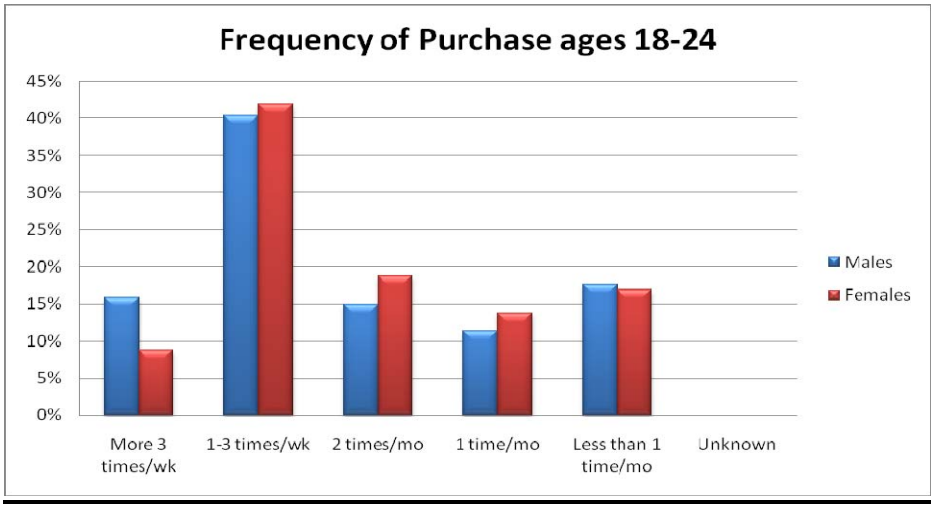

Figure 6 – Frequency of Purchases (18-24)

CHAPTER 5

Discussion

The demographic variables in this study indicate that students and persons aged 18-24 are the most frequent consumers of vending machine products on The Ohio State University's campus. They also indicate that if persons outside of the student and 18-24 year old demographic are to be included in the other vending consumption variables, the study will need to be expanded and a larger sample size will need to be obtained.

For the 18-24 year old demographic, this study suggests that the use of Snackwise® to increase the availability of healthful snack items in vending machines may not necessarily impact the frequency of healthful item purchase. The red items were consistently chosen more often than the other items in the vending machines, despite the contract-specified ratio of 28.5% red, 43% yellow, and 28.5% green vending items in each machine. Therefore, further intervention or education beyond implementation of a healthy snack program may be needed to increase sales of healthful vending items.

Motivation for vending purchases was overwhelmingly influenced by "hunger and "convenience" factors. This contradicts previous findings where "taste" and "cost" were the most frequent driving factors behind food and vending choices (8, 9, 10). It may be that because hunger and convenience were the first two factors listed on the data collection sheet, vending consumers were more likely to choose those factors when

prompted. This could especially be the case because interviewers were instructed to prompt vending consumers with the different options if the consumers could not think of a reason. If a similar study is to be conducted in the future, a suggestion should be given to either not prompt consumers, or vary the order of choices on the data collection sheet. However, because studies about vending consumers at a college or university have not been found in the literature, it may be that this demographic is motivated by different factors than the adult population as a whole. Nonetheless, hunger and convenience are two factors to consider when designing interventions that promote healthy vending items to this population.

Although the most often reported frequency for vending machine purchases was 1 to 3 times per week (41%), it is also important to note that, when persons who reported frequenting machines more than 3 times per week are factored in (12%), over 50% of the 18-24 year old sample reports making vending machine purchases at least 1 time per week (53%). This figure indicates that a successful intervention promoting healthy vending purchases could have a significant nutritional impact on a large portion of vending consumers aged 18-24.

Limitations

There are a few limitations to this study that must be considered when reviewing the results. The similarities between the Week 1 and Week 2 samples, despite being collected in different buildings, suggest that an accurate snapshot of vending consumers was captured. However, it is important to note that this sample does not reflect the vending population as a whole. First, the sample was not large enough to include the

smaller demographics in the vending choice, reason and frequency objectives. Also, the study was conducted over two consecutive weeks and does not reflect how vending patterns may change throughout the school year. Another limitation is the small size of the residence hall sample, which limited valid comparison between the residential and classroom building findings.

Additionally, the original convenience sample building plan was not followed as intended. Originally, Dulles Hall was the small classroom building to be studied during Week 1 of data collection. However, the actual machine that was studied was in University Hall. Therefore, there is a limitation to determining if classroom size makes a difference in the data due to the fact that University Hall is not a small classroom. An unexpected benefit from this alteration is that University Hall's vending machine got much higher traffic than the one in Dulles Hall. This likely increased the overall sample size a considerable amount and could be a factor as to why the Week 1 dataset had considerably more respondents than Week 2.

Another limitation to the study is due to machine error. The vending machine at McPherson Lab during Week 1 was not working for most of the time data was collected. We remedied this error by changing our collection procedures and asking consumers who attempted to purchase items from the machine what they would have purchased if the machine was working. We then went through the questionnaire as though they had actually made a purchase. It is unclear what effect this had on the data collected from McPherson Lab, but the sample size from that location was still very large.

Implications for Future Research

Future research should investigate whether time of day affects the rate of vending purchases. Also, 24-hour purchase data from the vending machine company should be evaluated to determine the percentage of purchases captured in the 12-hour frame of study. This will enable us to discover whether or not the time frame for data collection should be adjusted, especially based on building type. Another goal of future research should be to expand the study and acquire a larger sample size. This will enable the inclusion of data from smaller demographics such as faculty, staff and persons over the age of 24. Inclusion of these demographics may reveal differences in purchasing behavior, motivation, or frequency, and may have an impact on the ability to tailor more specific interventions. Furthermore, future research should investigate which interventions may prove to be the most effective in impacting the sales of healthful vending items to a college campus population.

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Appendix A: Consent Form

Consent Script:

Hello my name is [Interviewer's name] and I am a student with the Department of Human Nutrition researching vending machine use on campus. I would like to ask you 4 quick questions about your purchase. The information you share with me will be very valuable in helping me to complete this research project. No personal information or identifiers will be collected from you. Participation is voluntary and you are free to decline participation or stop participating at any time. Do you agree to participate?

Appendix B: Data Collection Sheet

Data Collection Sheet

Purchase Demographics

Vending Machine Location (Building Name) _____

Time of Purchase: _____

Observable Data
(Circle One / Write In)

1. Gender: Male Female

2. Item Purchased: _____

Will Consumer Participate in Questionnaire? Yes No

If Yes:

Intercept Survey
(Write In Answers of Respondents)

1. What is your affiliation to the University? (Circle one)

a.Student b.Staff c. Faculty d.Other (write in) _____

2. How frequently do you make vending machine purchases? (Check one)

___ a.More than 3 times/week ___ b.1 – 3 times/week

___ c.2 times/month ___ d.1 time/month

___ e.Less than 1 time/month ___ f.Unknown

3. Why do you purchase foods from a vending machine? (Circle one)

a.Hunger b.Convenience c.Cost d.Taste e.Other _____

4. How old are you? (circle one)

a.18-24 b.25-34 c.35-44 d.45-54 e.55+ f.Unknown